WHAT IS CLAIMED IS:

1. An etching apparatus, comprising:

an etching chamber for receiving a sample to be etched;

a source of etching gas; and

a collapsible, variable volume expansion chamber, said expansion chamber being in selective fluid communication with said source of etching gas and said etching chamber.

2. An etching apparatus according to claim 1, wherein said etching gas comprises xenon difluoride and said source of etching gas comprises a vacuum tight container holding xenon difluoride crystals.

3. An etching apparatus according to claim 1, further comprising a source of mixing gas in selective fluid communication with said expansion chamber.

4. An etching apparatus according to claim 3, wherein said mixing gas comprises nitrogen.

5. An etching apparatus according to claim 1, further comprising a vacuum pump in selective fluid communication with said expansion chamber and said etching chamber.

6. An etching apparatus according to claim 1, further comprising a heating and control apparatus for controlling a temperature of said etching chamber and a temperature of said expansion chamber.

7. An etching apparatus according to claim 1, wherein said expansion chamber comprises a bellows.

8. An etching apparatus according to claim 7, wherein said bellows comprise stainless steel edge welded bellows.

9. An etching apparatus according to claim 1, wherein said expansion chamber comprises a fixed volume chamber having an interior moveable piston.

10. An etching apparatus according to claim 1, further comprising a sample load lock coupled to said etching chamber.

11. An etching apparatus according to claim 1, wherein a maximum volume of said expansion chamber is greater than a volume of said etching chamber.

12. An etching apparatus according to claim 1, further comprising a residual gas analysis apparatus coupled to said etching chamber.

13. An etching apparatus according to claim 1, further comprising means for analyzing gasses drawn from said etching chamber.

14. A method of etching a sample held in an etching chamber at a desired etch pressure, comprising the steps of:

setting a volume of a collapsible, variable volume expansion chamber to an initial volume and feeding an etching gas into said expansion chamber from a source having a source pressure;

placing said expansion chamber in fluid communication with said etching chamber;

collapsing said expansion chamber; and

maintaining said expansion chamber and said etching chamber at temperatures at which said etching gas will not solidify at said etch pressure.

15. A method according to claim 14, wherein said initial volume is determined by multiplying a volume of said etching chamber by said etch pressure and dividing a result of said multiplication by said source pressure

16. A method according to claim 14, further comprising the steps of:

removing said expansion chamber from fluid communication with said etching chamber after said collapsing step;

repeating said setting and feeding steps;

determining that an etch process taking place in said etching chamber is complete;

evacuating said etching chamber after said determining step; and

repeating said placing and collapsing steps after said evacuating step.

17. A method according to claim 16, wherein said determining step comprises determining that an etch time has elapsed.

18. A method according to claim 16, wherein said determining step comprises analyzing gasses drawn from said said etching chamber and determining that said etch process is complete when the concentrations of one or more elements or compounds reaches a preset value.

19. A method according to claim 14, wherein said etching gas comprises xenon difluoride.

20. A method according to claim 14, wherein said feeding step further comprises feeding a mixing gas into said expansion chamber from a source of mixing gas, said source of mixing gas being at said source pressure.

21. A method according to claim 20, wherein said mixing gas comprises nitrogen.

22. A method according to claim 20, wherein said feeding step continues until a pressure inside said expansion chamber equals a predetermined set point pressure.

23. A method according to claim 14, wherein said feeding step continues until a pressure inside said expansion chamber equals a predetermined set point pressure.

24. A method according to claim 16, further comprising the step of evacuating said expansion chamber before said feeding step.

25. An etching apparatus, comprising:

an etching chamber for receiving a sample to be etched;

a source of etching gas;

a first expansion chamber in selective fluid communication with said source of etching gas and said etching chamber; and

a second expansion chamber in selective fluid communication with said source of etching gas and said etching chamber.

26. An etching apparatus according to claim 25, wherein said etching gas comprises xenon difluoride and said source of etching gas comprises a vacuum tight container holding xenon difluoride crystals.

27. An etching apparatus according to claim 25, further comprising a source of mixing gas in selective fluid communication with said first expansion chamber and said second expansion chamber.

28. An etching apparatus according to claim 27, wherein said mixing gas comprises nitrogen.

29. An etching apparatus according to claim 25, further comprising a second source of etching gas in selective fluid communication with said first expansion chamber and said second expansion chamber.

30. An etching apparatus according to claim 25, further comprising a vacuum pump in selective fluid communication with said first expansion chamber, said second expansion chamber and said etching chamber.

31. An etching apparatus according to claim 25, further comprising an automatic heating and control apparatus for controlling a temperature of said etching chamber, a temperature of said first expansion chamber, and a temperature of said second expansion chamber.

32. An etching apparatus according to claim 25, further comprising a sample load lock coupled to said etching chamber.

33. An etching apparatus according to claim 25, further comprising a residual gas analysis apparatus coupled to said etching chamber.

34. An etching apparatus according to claim 25, further comprising means for analyzing gasses drawn from said etching chamber.

35. An etching apparatus according to claim 25, wherein said first and second expansion chambers have a fixed volume.

36. An etching apparatus according to claim 25, further comprising a third expansion chamber in selective fluid communication with said source of etching gas and said etching chamber.

37. An etching apparatus according to claim 36, said first expansion chamber having a fixed volume equal to A, said second expansion chamber having a fixed volume equal to 2A, and said third expansion chamber having a fixed volume equal to 4A.

38. An etching apparatus according to claim 36, said first expansion chamber having a first fixed volume, said second expansion chamber having a second fixed volume, and said third expansion chamber having a third fixed volume, said first, second and third fixed volumes being equal to one another.

39. An etching apparatus according to claim 27, wherein one of said first and second expansion chambers comprise a variable volume expansion chamber.

40. An etching apparatus according to claim 27, wherein said first and second expansion chambers each comprise a variable volume expansion chamber.

41. An etching apparatus according to claim 27, wherein said source of etching gas is in selective fluid communication with said etching chamber.

42. An etching apparatus according to claim 41, further comprising a flow controller connected between said source of etching gas and said etching chamber and a vacuum pump in selective fluid communication with said etching chamber.

43. An etching apparatus according to claim 42, further comprising a source of mixing gas in selective fluid communication with said etching chamber and a second flow controller connected between said source of mixing gas and said etching chamber.

44. An etching apparatus according to claim 42, further comprising means for controlling the conductance of said vacuum pump.

45. An etching apparatus according to claim 41, wherein said source of etching gas comprises first and second vacuum tight containers holding said etching gas,

said first vacuum tight container and said second vacuum tight container each in selective fluid communication with said second etching chamber, said apparatus further comprising a first flow controller connected between said first vacuum tight container and said etching chamber, a second flow controller connected between said second vacuum tight container and said etching chamber, and a vacuum pump in selective fluid communication with said etching chamber.

46. An etching apparatus according to claim 45, further comprising a source of mixing gas in selective fluid communication with said etching chamber and a third flow controller connected between source of mixing gas and said etching chamber.

47. An etching apparatus according to claim 45, further comprising means for controlling the conductance of said vacuum pump.

48. An etching apparatus, comprising:

a source of etching gas;

an etching chamber in selective fluid communication with said source of etching gas;

a flow controller connected between said source of etching gas and said etching chamber; and

a vacuum pump in selective fluid communication with said etching chamber.

49. An etching apparatus according to claim 48, wherein said etching gas comprises xenon difluoride.

50. An etching apparatus according to claim 48, further comprising a source of mixing gas in selective fluid communication with said etching chamber and a second flow controller connected between said source of mixing gas and said etching chamber.

51. An etching apparatus according to claim 50, wherein said mixing gas comprises nitrogen.

52. An etching apparatus according to claim 48, wherein said source of etching gas comprises a vacuum tight container having a mesh mounted in the interior thereof, said mesh being adapted to hold a solid material used to generate said etching gas.

53. An etching apparatus according to claim 52, where said etching gas comprises xenon difluoride, said solid material comprises xenon difluoride crystals, and said etching gas is generated through sublimation.

54. An etching apparatus according to claim 52, wherein said mesh has a W-shaped cross section.

55. An etching apparatus according to claim 54, wherein said vacuum tight container has a cylindrical shape.

56. An etching apparatus according to claim 55, wherein said vacuum tight container comprises a standard gas cylinder.

57. An etching apparatus according to claim 52, wherein said mesh comprises a material chosen from the group of consisting of aluminum, stainless steel and Teflon.

58. An etching apparatus according to claim 53, said mesh having a plurality of openings, each of said openings being sized to be smaller than an average size of said xenon difluoride crystals.

59. A source for providing a gas by sublimation from a solid material, comprising:

a vacuum tight container; and

a mesh mounted in the interior of said vacuum tight container, said mesh being adapted to receive and restrain said solid material.

60. A source according to claim 59, wherein said mesh has a W-shaped cross section.

61. A source according to claim 59, wherein said mesh has a WW-shaped cross section.

62. A source according to claim 59, wherein said vacuum tight container has a cylindrical shape.

63. A source according to claim 62, wherein said vacuum tight container comprises a standard gas cylinder.

64. A source according to claim 59, wherein said mesh comprises a material chosen from the group consisting of aluminum, stainless steel and Teflon.

65. A source for providing an etching gas to an etching apparatus by sublimation from a solid material, comprising:

a vacuum tight container; and

a mesh mounted in the interior of said vacuum tight container, said mesh being adapted to receive and restrain said solid material.

66. A source according to claim 65, wherein said etching gas comprises xenon difluoride and said solid material comprises xenon difluoride crystals.

67. A source according to claim 65, wherein said mesh has a W-shaped cross section.

68. A source according to claim 65, wherein said mesh has a WW-shaped cross section.

69. A source according to claim 65, wherein said vacuum tight container has a cylindrical shape.

70. A source according to claim 69, wherein said vacuum tight container comprises a standard gas cylinder.

71. A source according to claim 65, wherein said mesh comprises a material chosen from the group consisting of aluminum, stainless steel and Teflon.